

REMARKS

Reconsideration of the present application is respectfully requested.

Applicants note with appreciation the acknowledgement of the claim for priority under section 119 and the notice that all of the certified copies of the priority documents have been received.

Applicants also appreciate receiving a copy of form PTO-1449, on which the Examiner has initialed all listed items.

Claims 1, 2, 4 and 16-24 are pending.

Please cancel withdrawn claims 5-15 without prejudice or disclaimer.

The drawings were objected to under 37 CFR 1.84(p)(5) for including reference signs 39a and 39b of FIG. 1D that are not included in the specification. In response, Applicants have amended the specification on page 9, line 11 by changing reference numeral 39a to 39b for the item "another hole" in the specification. The Examiner should note the amendments that were already made to the paragraph beginning at page 9, line 8 in the Amendment filed on September 10, 2002.

Claim 19 was objected to for the informality in line 1 "the metal is tin" where it should read "the first metal is tin." In response, Applicants have amended Claim 19 as suggested.

Remaining claims 1,2, 4, 16-19 and 22-24 have been rejected under 35 USC 112 second paragraph as being indefinite.

Regarding claim 1, the Examiner asserts the limitation in line 6, "the conductor patterns on the sidewall," as well as the language in lines 6-8, "a shape in such a manner that the farther from the conductor patterns on the sidewall, the closer to the center axis of the via-hole" is

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unclear. Applicants have amended the claim to better describe the shape of the sidewall of the unified conductive compound.

The Examiner also asserts that the language in lines 4 and 12 is unclear as to the connection and placement of the conductive patterns, the solid phase diffusion layers and the unified conductive compound. In response, Applicants have amended claim 1 to show the physical relationship and electrical connection between each of the pair of conductive patterns.

The Examiner also found claim 1 lines 13 and 14 to contain product by process language: “formed by mutual solid phase diffusion between the same metal as the metal in the conductor patterns and the same metal as the first metal in the conductive compound.” In response Applicants have amended the claim to recite first and second solid phase diffusion layers and their composition in a non-product by process format.

Regarding claim 17, the Examiner states that the structural relationship between the pair of solid phase diffusion layers and the remaining structure and the electrical interconnection between elements are unclear. Applicants have amended the claim to recite more clearly the above structural relationship and the electrical interconnection between elements.

Regarding claim 22, the Examiner states the recitation, “a shape such that the farther from the conductor patterns on the sidewall, the closer the sidewall is to a center axis of the via-hole to the center axis of the via-hole.” is unclear. Applicants have amended the claim to recite that the protrusion is convex as shown, for example, in FIG. 3 #23.

Regarding claim 24, the Examiner states that the recitation, “the sidewall of the unified conductive compound is inclined with respect to the conductor patterns” is vague due to lack of definition of the location of the conductive patterns. Applicants state the amendment to base

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claim 1 stating the location of the conductive patterns clarifies the relationship of the via-hole filling compound to the conductive patterns.

In view of the above remarks and amendments, Applicants respectfully request that the rejection of claims 1,2,4, 16-19 and 22-24 under 35 USC 112 second paragraph be withdrawn.

Remaining claims 1, 2, 4, 16, and 23-24 have been rejected under 35 USC 103(a) as being unpatentable over Takubo et al., US 6329610 (Takubo) in view of Takenouchi et al., US 5744758 (Takenouchi). Applicants respectfully traverse the rejection.

The present invention in amended independent claims 1, 17 and 20 recites inter alia a printed wiring board with a unified conductive compound formed from first and second metals, for example, silver and tin, and teaches that the first and second metals form an alloy. Further, the tin of the unified conductive compound and metal from the first and second conductor patterns form a solid phase diffusion layer providing improved electrical connection and mechanical durability over the cited art.

The Examiner states, “it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takubo and Takenouchi in order to incorporate the unified conductive compound taught by Takenouchi reference to the Takubo structure.....”

Takubo, at column 12 line 60, teaches a hybrid wiring board having a conductive column that is mechanically pressed against, rather than diffused into, the conductive layer to form the electrical connection during assembly. However, Takubo does not teach or suggest the solid phase diffusion layer for increased electrical connectivity and mechanical strength or the reduced angle of incidence of the unified conductive compound to the first and second conductive

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patterns for improved resistance to damage from mechanical stress as recited in the presently rejected claims.

The Examiner asserts inter alia that Takenouchi teaches a printed circuit board having a via-hole with a unified conductive compound 20 comprising a first metal and a second metal ... and that the conductor patterns are electrically interconnected using solid phase diffusion layers. Takenouchi does describe an electro-conductive thermoplastic polyimide 20 that becomes adhesive (column 5 line 26) during the formation of the electrical connection. However, the metal of the conductive pattern does not react or diffuse into the thermoplastic polyimide. More specifically, the electro-conductive thermoplastic polyimide contains a single electro-conductive material, such as gold, silver, copper, nickel, lead or others (column 6 lines 6-8). The second metal that the Examiner references (column 7, lines 56 and 57) is copper or tin that is plated on a via for attaching a solder bump. However, the second metal is not integral with the electro-conductive thermoplastic polyimide. Also, Takenouchi does not teach or suggest that the tin-plating on the via interacts with the thermoplastic polyimide column filling the via to form an alloy or a solid phase diffusion layer.

Therefore, the combination of Takubo and Takenouchi does not teach the use of a two metal unified conductive compound capable of forming the solid phase diffusion layer as recited in claims 1, 17 and 20 of the present invention; rather, Takenouchi describes a single metal compound 20 that is filled into a via 18 that in some cases is plated with tin. In fact, Applicants assert that there is no motivation to incorporate the via configuration of Takenouchi into Takubo, as the side plating of the via hole 18 of Takenouchi could be mechanically damaged due to deformation thereof during resin bonding of the insulation layers of Takubo 21-23. The combination of Takubo with Takenouchi therefore does not result in the present invention.

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Regarding claims 2 and 23, the Examiner states that Takubo teaches the shape of the wall of the conductive compound as recited. Applicants have amended the claims to cite that the arch/convex shape is between the first and second solid phase diffusion layers as shown, for example, in FIG. 3 reference number 24.

Regarding claim 4, Examiner states that the claim contains product-by-process language. In response, Applicants have amended the claim to recite the unified conductive compound is a sintered metal.

Regarding claim 16, Examiner states the Takubo as modified by Takenouchi teaches the first metal is tin and the second metal is silver. As stated above, Applicants assert that the two metal, i.e. silver and tin, composition of the unified conductive compound of the current invention is not taught by the silver-filled electro-conductive thermoplastic polyimide and tin-plated via hole of Takenouchi.

Regarding claim 24, the Examiner states that Takubo teaches that the sidewall of the unified conductive compound is inclined with respect to the conductor patterns, wherein stress concentrations are avoided at an area of electrical contact. Applicants assert that the mechanical contact of the via land pressed onto the conductive pillar (column 12 line 30) of Takubo is not equivalent to the chemical alloy process, that is, the solid diffusion layers, of the current invention. The angle of the sidewall and structure of the connection formed between the unified conductive compound, the solid diffusion layer and the conductive pattern on each side of the insulator board of the current invention create a unique connection better suited to avoid stress concentrations at the area of electrical contact than that of Takubo.

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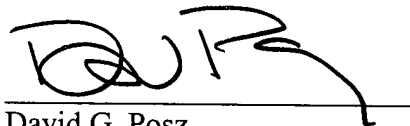
Regarding claim 18, Examiner states that the claim contains product-by-process language. In response, Applicants have amended the claim to recite the unified conductive compound is an alloy that includes sintered metals.

In summary, the two-metal unified conductive compound and the solid phase diffusion layer resulting from a reaction between the unified conductive compound and the first and second conductive patterns of the printed wire board of the present invention are unique with respect to the combination of Takubo and Takenouchi. The improved electrical connection and resistance to stress at the point of electrical contact between the unified conductive compound and the first and second conductor patterns represent improvements over the teachings of the cited references. Therefore, Applicants respectfully request that the rejection under 35 USC 103(a) of claims 1, 17, and 20 and dependent claims 2, 4, 16, 18-19, and 21-24 be withdrawn.

In view of the foregoing, Applicants respectfully submit that this application is in condition for allowance. A timely notice to that effect is respectfully requested. If questions relating to patentability remain, the Examiner is invited to contact the undersigned by telephone.

Although no fees are believed to be due, please charge any additional unforeseen fees that may be due to Deposit Account No. 50-1147.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'D. Posz', written over a horizontal line.

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